REPORT NO. EVT 32-87

MIL-STD-1660 TEST OF UNITIZATION PROCEDURE FOR 105MM WHITE PHOSPHORUS (WP) PROJECTILES

US ARMY
ARMAMENT
MUNITIONS
CHEMICAL COMMAND

US ARMY DEFENSE AMMUNITION
CENTER AND SCHOOL

EVALUATION DIVISION
SAVANNA, ILLINOIS 61074-9639

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Shipping Container

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

-The U.S. Army Defense Ammunition Center and School (USADACS) has been tasked by the U.S. Army Armament Research, Development and Engineering Center, SMCAR-ESK, thru the Storage and Outloading Division, USADACS, to test a unitization procedure for the shipment of 75mm thru 106mm/4.2" white phosphorus (WP) projectiles. Projectiles received for testing were inert-filled 105mm WP, weighing about 25 lbs each. These projectiles were unitized in accordance with the unitization

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procedure and subjected to the MIL-STD-1660 design criteria for ammunition unit loads. The unitization for the 105mm WP projectiles satisfactorily completed this testing sequence.

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U.S. Army Defense Ammunition Center and School
Savanna, IL 61074-9639

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MIL-STD-1660 TEST

OF UNITIZATION PROCEDURE FOR 105MM

WHITE PHOSPHORUS (WP) PROJECTILES

TABLE OF CONTENTS

ABSTRACT

The U.S. Army Defense Ammunition Center and School (USADACS) has been tasked by the U.S. Army Armament Research, Development and Engineering Center, ARDEC, SMCAR-ESK, thru the Storage and Outloading Division, USADACS, to test a unitization procedure for the shipment of 75mm thru 106mm/4.2" white phosphorus (WP) projectiles. Projectiles received for testing were inert-filled 105mm WP, weighing about 25 lbs each. These projectiles were unitized in accordance with the unitization procedure and subjected to the MIL-STD-1660 design criteria for ammunition unit loads. The unitization for the 105mm WP projectiles satisfactorily completed this testing sequence.

PART I

A. INTRODUCTION. The U.S. Army Defense Ammunition Center and School (USADACS), Evaluation Division, was tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), SMCAR-ESK, Rock Island, IL, thru the Storage and Outloading Division, USADACS, to test the unitization procedure for 105mm WP projectiles in accordance with MIL-STD-1660 testing criteria. This unitization procedure is for the shipment of 75mm thru 106mm/14.2" projectiles. This report contains the results of the MIL-STD-1660 tests.

B. AUTHORITY. These tests were conducted in accordance with mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM).

C. OBJECTIVE. The objective of the MIL-STD-1660 testing sequence is to verify the unitization procedure for 105mm WP projectiles.

PART II

ATTENDEES

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PART III.

TEST PROCEDURES

The test procedures outlined in this section are extracted from MIL-STD 1660, Design Criteria for Ammunition Unit Loads dated 8 April 1977. This standard identifies nine steps that a unitized load must undergo if it is considered to be acceptable. These tests are synopsized below:

1. STACKING TESTS. The unit load shall be loaded to simulate a stack of identical unit loads stacked 16-feet high, for a period of one hour. This stacking load is simulated by subjecting the unit load to a compression of weight equal to an equivalent 16-foot stacking height. The compression load is calculated in the following manner. The unit load weight is divided by the unit load height in inches and multiplied by 192. The resulting number is the equivalent compressive force of a 16-foot high load.

2. REPETITIVE SHOCK TEST. The repetitive shock test shall be conducted in accordance with Method 5019, Federal Standard 101. The test procedure is as follows: The test specimen shall be placed on, but not fastened to, the platform. With the specimen in one position, vibrate the platform at 1.0-inch amplitude (1-inch double amplitude) starting at a frequency of about 3-cycles per second. Steadily increase the frequency until the package leaves the platform. The resonant frequency is achieved when a 1/16-inch thick feeler may be momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle or a platform acceleration achieves one plus or minus zero point one G. Midway into the testing period the specimen shall be rotated 90 degrees and the test continued for the duration. If failure occurs, the total time of vibration shall be two hours if the specimen is tested in one position; and if tested in more than one

position, the total time shall be three hours.

3. EDGEWISE DROP TEST. This test shall be conducted by using the procedures of Method 5008, Federal Standard 101. The procedure for the Edgewise Drop (Rotational) Test is as follows: The specimen shall be placed on its bottom with one end of the base of the container supported on a sill nominally 6-inches high. The height of the sill shall be increased if necessary to ensure that there will be no support for the base between the ends of the container when dropping takes place, but should not be high enough to cause the container to slide on the supports when the dropped end is raised for the drops. The unsupported end of the container shall then be raised and allowed to fall freely to the concrete, pavement, or similar underlying surface from a prescribed height. Unless otherwise specified, the height of drop for level A protection shall conform to the following tabulation.

GROSS WEIGHT NOT EXCEEDING	DIMENSIONS ON ANY EDGE NOT EXCEEDING	HEIGHT OF DROP LEVEL A PROTECTION
Pounds	Inches	Inches
600	72	36
3,000	no limit	24
no limit	no limit	12

4. IMPACT TEST. This test shall be conducted by using the procedure of Method 5023, Incline-Impact Test of Federal Standard 101. The procedure for the Incline-Impact Test is as follows:

The specimen shall be placed on the carriage with the surface or edge which is to be impacted projecting at least 2-inches beyond the front end of the carriage. The carriage shall be brought to a predetermined position on the incline and released. If it is desired to concentrate the impact on any

particular position on the container, a 4x4-inch timber may be attached to the bumper in the desired position before the test. No part of the timber shall be struck by the carriage. The position of the container on the carriage and the sequence in which surfaces and edges are subjected to impacts may be at the option of the testing activity and will depend upon the objective of the tests. When the test is to determine satisfactory requirements for a container or pack, and unless otherwise specified, the specimen shall be subjected to one impact on each surface that has each dimension less than 9.5-feet. Unless otherwise specified, the velocity at time of impact shall be 7-feet per second.

PART IV.

TEST EQUIPMENT

1. TEST SPECIMEN.

   a. Drawing Number: Unitization Procedure

   b. Width: 40 in

   c. Length: 48 in

   d. Height: 22-1/2 in

   e. Weight: 2,050 lbs

2. COMPRESSION TESTER.

   a. Manufacturer: Ormond Scientific

   b. Platform: 60 inches by 60 inches

   c. Compression Limit: 50,000 pounds

   d. Tension Limit: 50,000 pounds

3. TRANSPORTATION SIMULATOR.

   a. Manufacturer: Gaynes Laboratory

   b. Capacity: 6,000-pound pallet

   c. 1/2-inch Amplitude

   d. Speed: 50 to 3000 cpm

   e. Platform: 5 foot by 8 foot

4. INCLINED RAMP.

   a. Manufacturer: Conbur Incline

   b. Impact Tester

   c. 10-Percent Incline

   d. 12-foot Incline

PART V

TEST RESULTS

1. STACKING TEST.

Pallet Weight: 2,050 lbs

Pallet Height: 22.5-in

Test Load: 17,500 lbs.

The subject pallet was loaded to 18,000 lbs compression for a period of one hour. At the end of that period of time, the compression load decreased to 17,000 lbs. When the test specimen was removed from the compression tester, no measurable deformation was realized.

2. REPETITIVE SHOCK TEST. The subject unitization successfully passed a longitudinal transportation test in a 90-minute period. Rotating the pallet 90 degrees and subjecting it to a second 90-minute period in the transportation simulator caused no damage to the unitization or loosening of the strapping. Operational speed for the transportation simulator was 175 rpm for the duration of the test. Input driving force from the transportation simulator during this test was 0.43 Gs acceleration.

3. EDGEWISE DROP TEST. Each side of the pallet base is placed, in turn, on a beam displacing it six inches above the floor. The opposite side is raised to a height of 24 inches above the floor and then dropped. At the conclusion of four edgewise rotational drops, one skid had cracked and partially separated from the base; this was the only damage caused to the unitization during testing.

4. INCLINED IMPACT. The unitization under test is placed on the inclined ramp sled so that two inches of the load extend in front of the sled. The sled with the unit load is raised approximately 36 inches and allowed to

freely roll down the ramp into a solid stop. The procedure used includes an optional 9-inch timber attached to the incline ramp wall. The optional timber impacts the whole height of the skid and part of the base of the unit load. This procedure is repeated once on each side of the unitization. No damage occurred to the unitization when subjected to the inclined impact test.

PART VI

CONCLUSIONS AND RECOMMENDATIONS

1. CONCLUSIONS. The unitization procedure for 105mm WP projectiles was tested in accordance with MIL-STD-1660 and passed all tests without sustaining damage that would render the box of projectiles to be unsafe in handling or transport.

2. RECOMMENDATIONS. It is recommended that this unitization procedure be accepted for transportation, storage, and handling of boxed 105mm WP projectiles.

PART VII

PHOTOGRAPHS

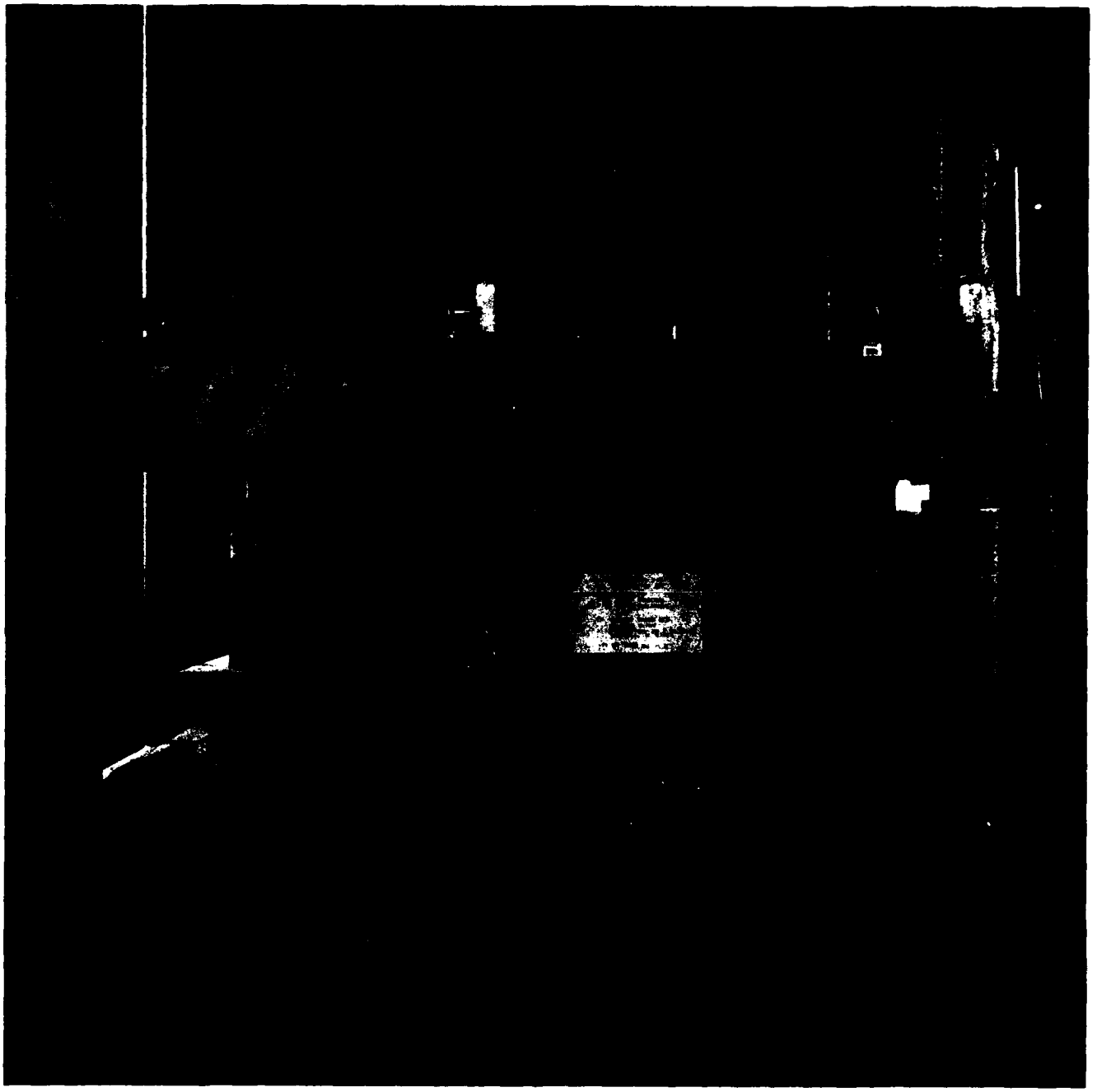

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Photo No. 1. This photo shows the unitization procedure in the compression tester loaded to approximately 17,500 lbs.

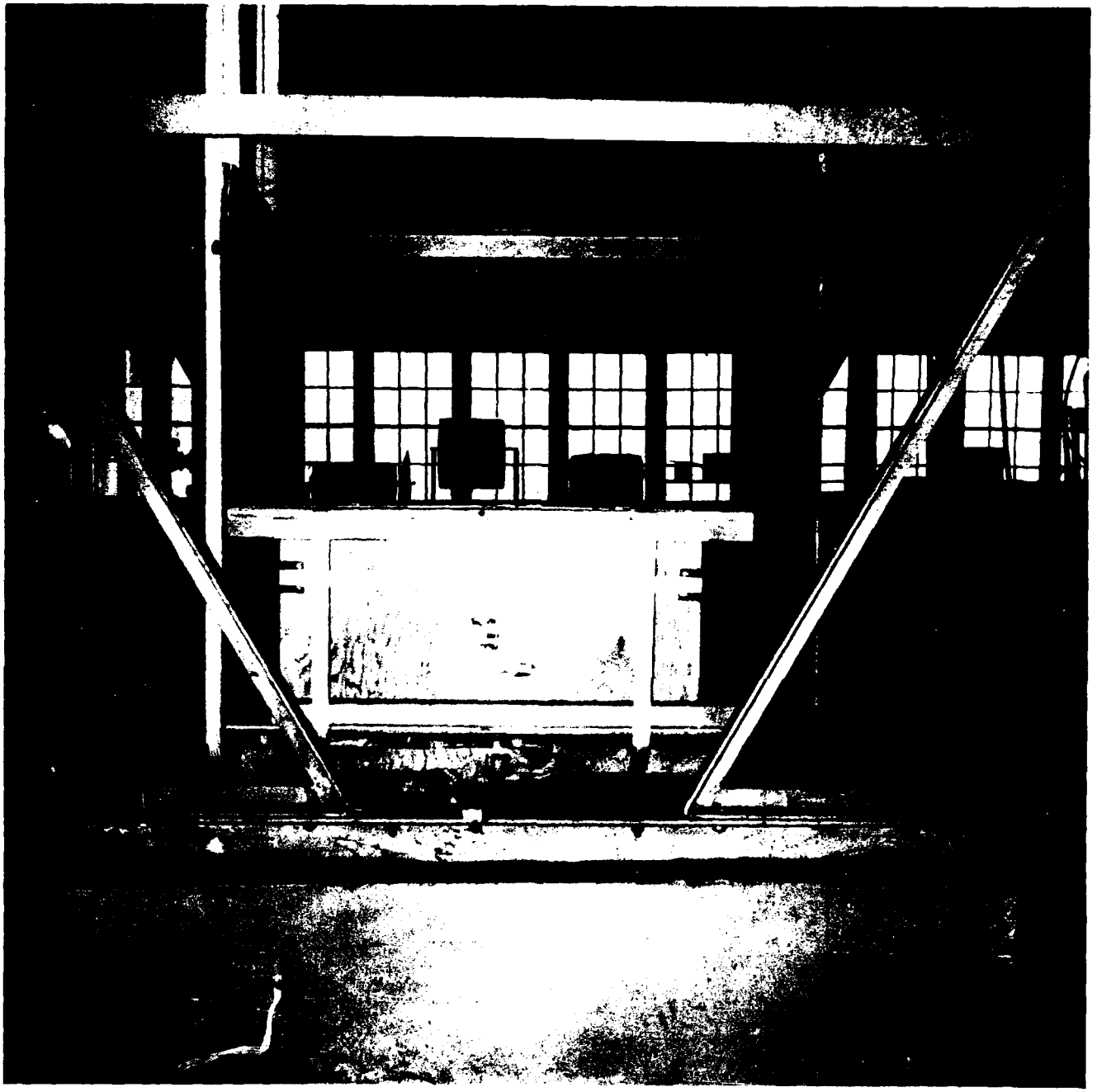

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Photo No. 2. This photo shows the unitization procedure for 105mm WP projectiles placed on the transportation simulator with a steel deck and operated at 175 rpm for a period of 90 minutes in the longitudinal orientation, and second 90-minute period in the lateral orientation.

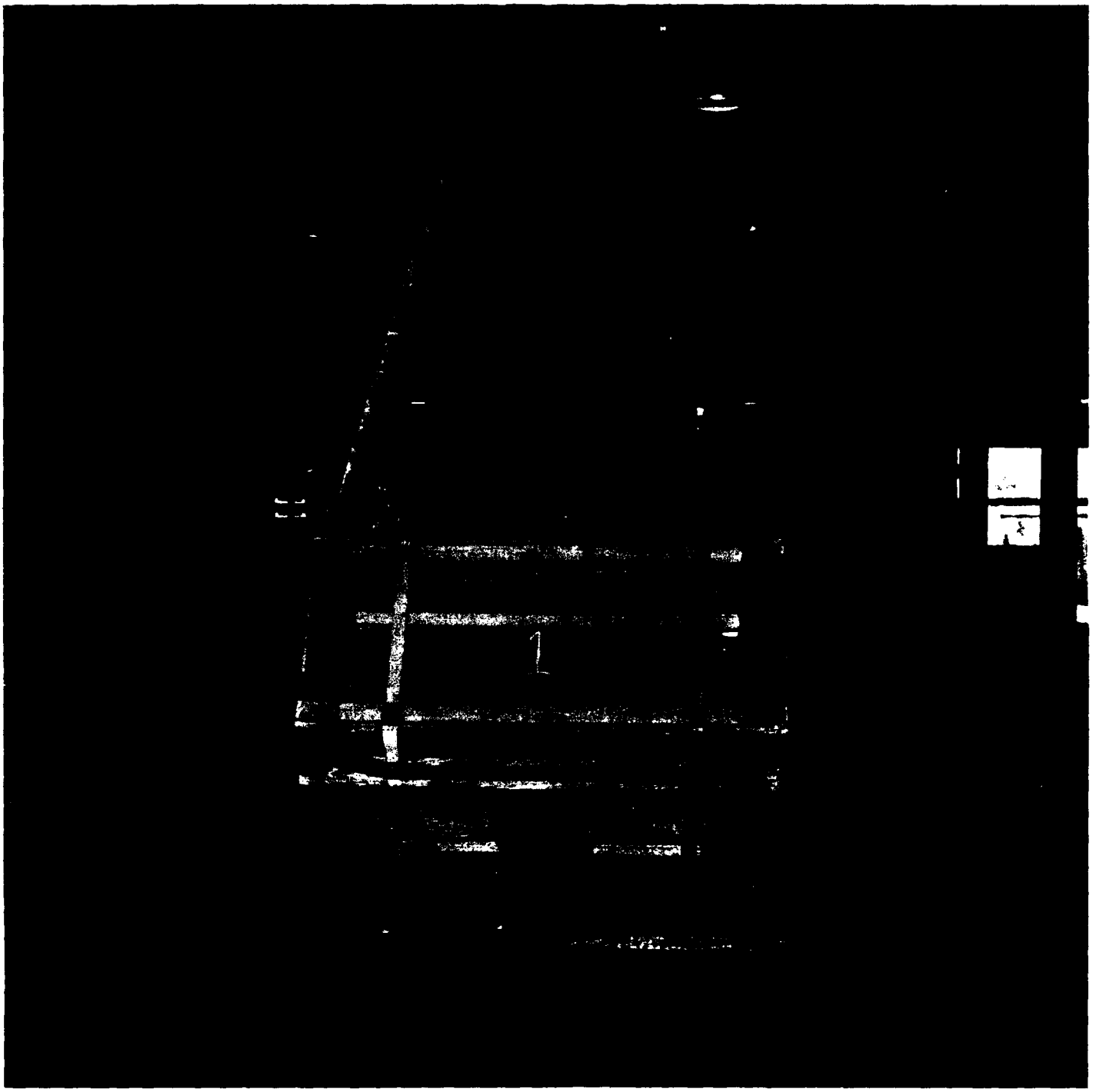

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Photo No. 3. This photo shows the unitization procedure for 105mm WP projectiles on the first edgewise drop test. Drop height is 24 inches. Damage was sustained in a single racked skid.

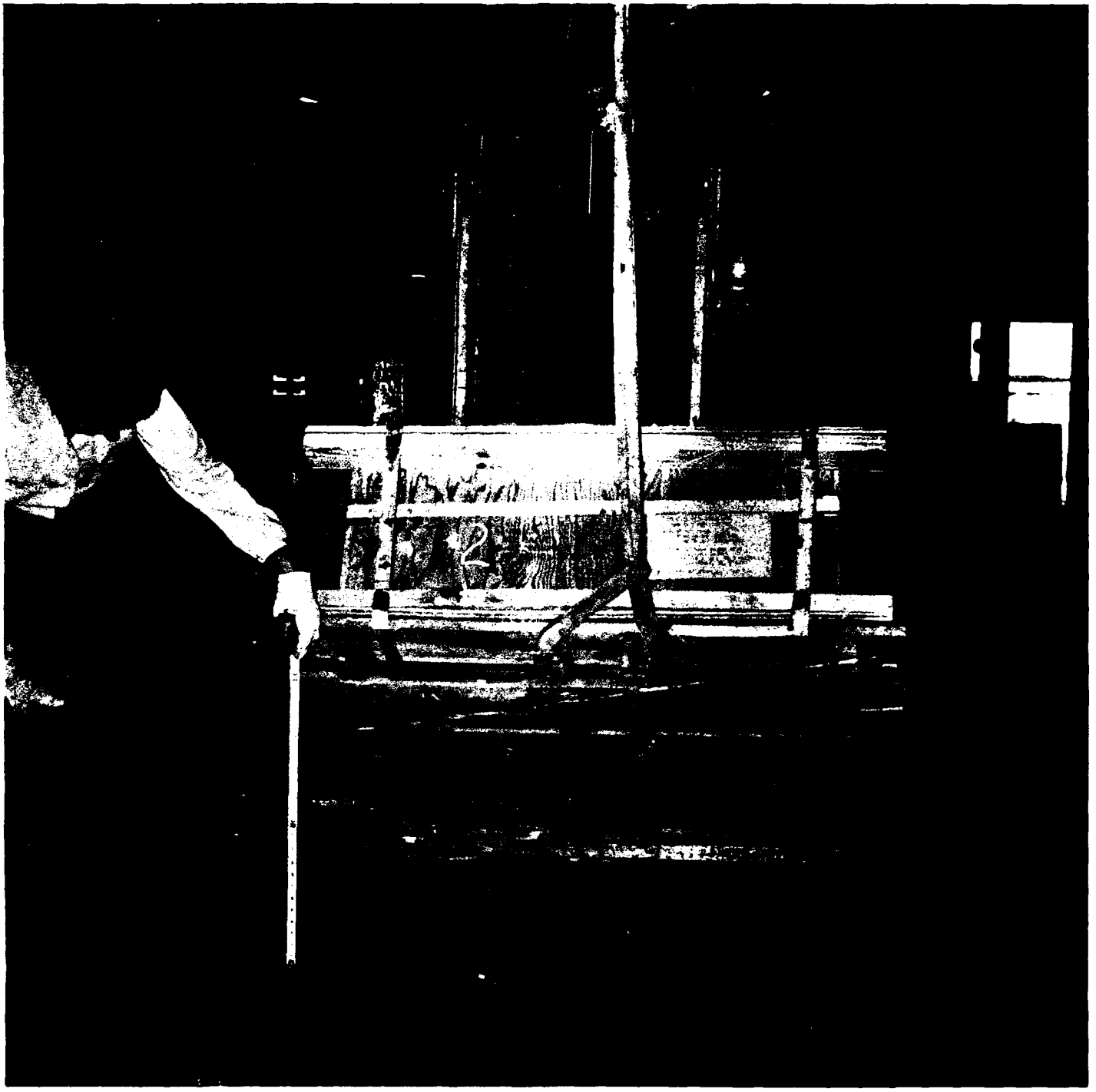

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Photo No. 4. This photo shows the unitization procedure for 105mm WP projectiles ready for the second edgewise drop test. Note the cracked upper skid from the first drop test. Drop height is 24 inches.

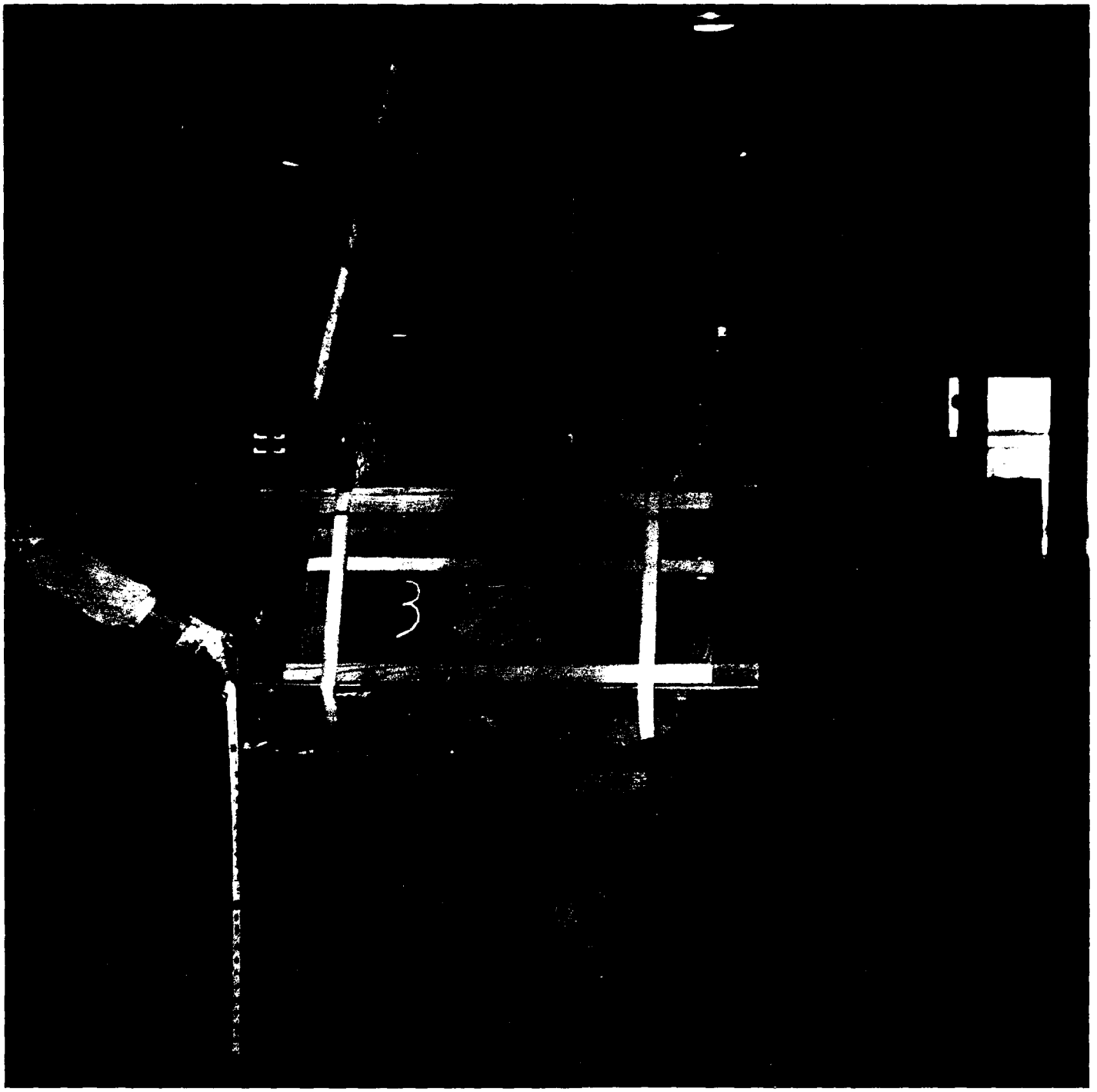

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Photo No. 5. This photo shows the unitization procedure for 105mm WP projectiles ready for the edgewise rotational drop on the third side. Drop height is 24 inches.

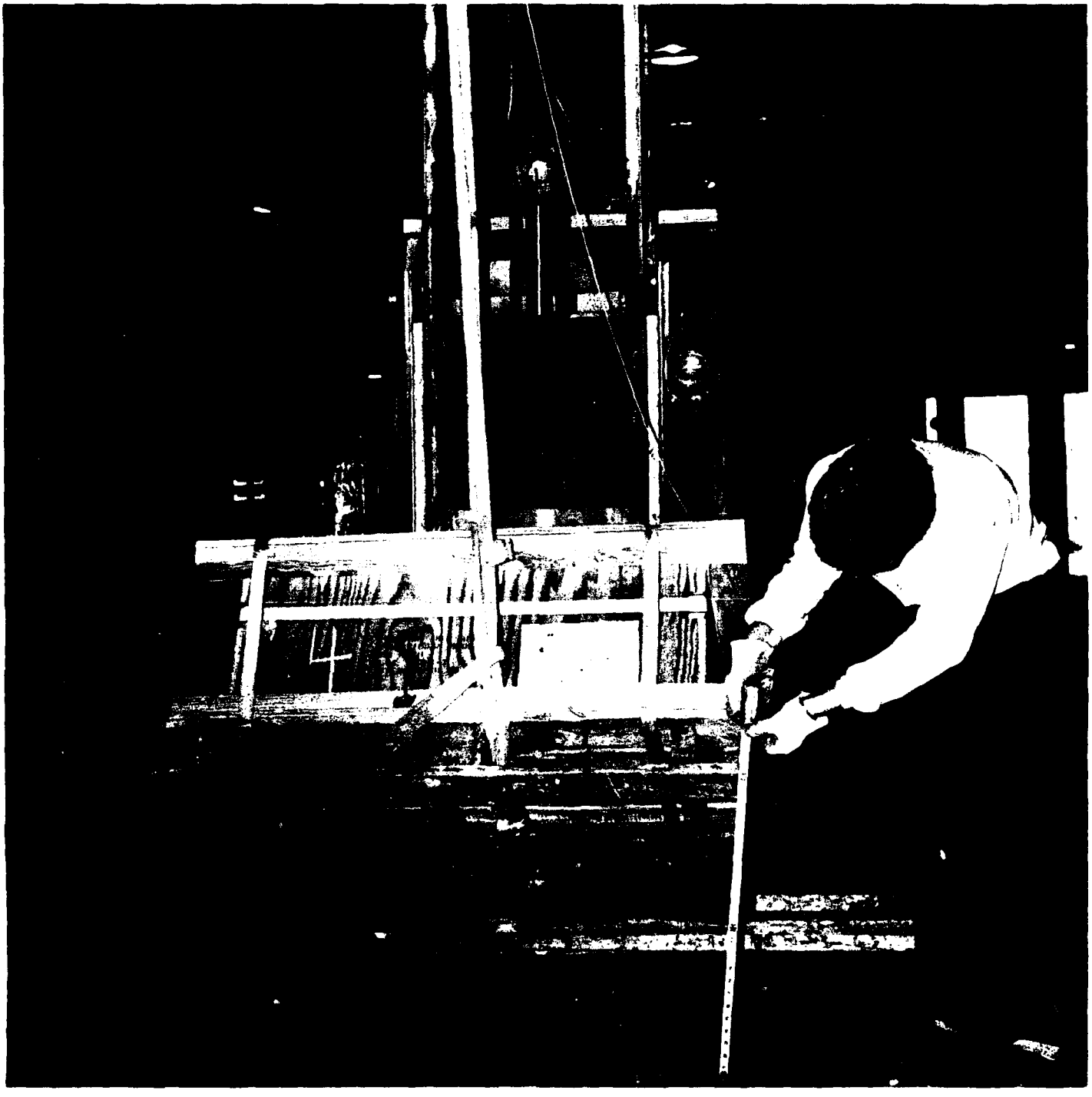

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Photo No. 6. This photo shows the unitization procedure for 105mm WP projectiles ready for dropping in the edgewise rotational drop on the fourth side. Drop height is 24 inches. No damage was sustained other than the one cracked skid.

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Photo No. 7. This photo shows the unitization procedure for 105mm WP projectiles after the incline impact test on the first side. No damage occurred to the unitization.

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Photo No. 8. This photo shows the unitization procedure for 105mm WP projectiles after the second impact on the inclined tester.

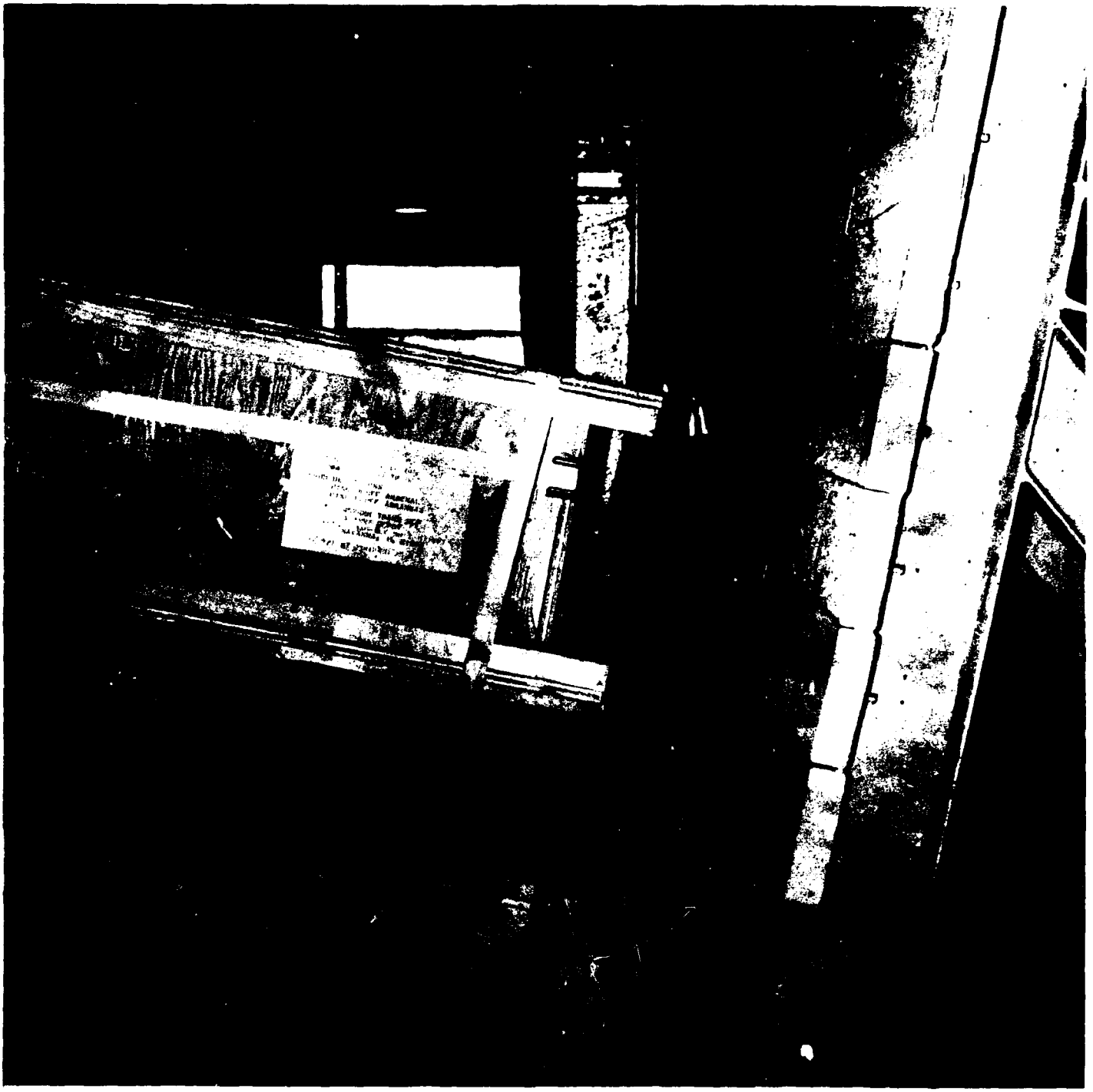

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Photo No. 9. This photo shows the unitization procedure for 105mm WP projectiles after the inclined impact test on the third surface. Note that the impact area is on the top of the pallet and the lower 2 X 4.

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Photo No. 10. This photo shows the unitization procedure for 105mm WP projectiles after the fourth inclined impact. No damage was sustained by the unitization.

PART VIII

UNITIZATION PROCEDURES

UNITIZATION PROCEDURES FOR 105MM WP PROJECTILES

This 6-sheet document delineates unitization procedures for loose 105MM white phosphorus projectiles.

MATERIAL SPECIFICATIONS

Pallet:	4-way entry, Style I, Type I, Class I, Mil Spec MIL-P-15011.
Lumber:	See TM 743-200-1, dunnage lumber, Fed Spec MM-L-751.
Nails:	Common, Fed Spec FF-N-105.
Strapping, Steel:	Class I, Type I or IV, heavy duty, finish A, B (Grade 2), or C; Fed Spec QQ-S-781.
Seal, Strap:	Type D, Style I, II or IV, Class H, Fed Spec QQ-S-781.
Staple:	15/16" wide, 3/4" leg length, Type III, Style 3, Fed Spec FF-N-105.
Plywood:	Group B, construction and industrial plywood, interior with exterior glue, Grade C-D. If specified grade is not available, a better interior or exterior grade may be substituted: Fed Spec NN-P-530.

Prepared during October 1987 by:

U.S. Army Defense Ammunition
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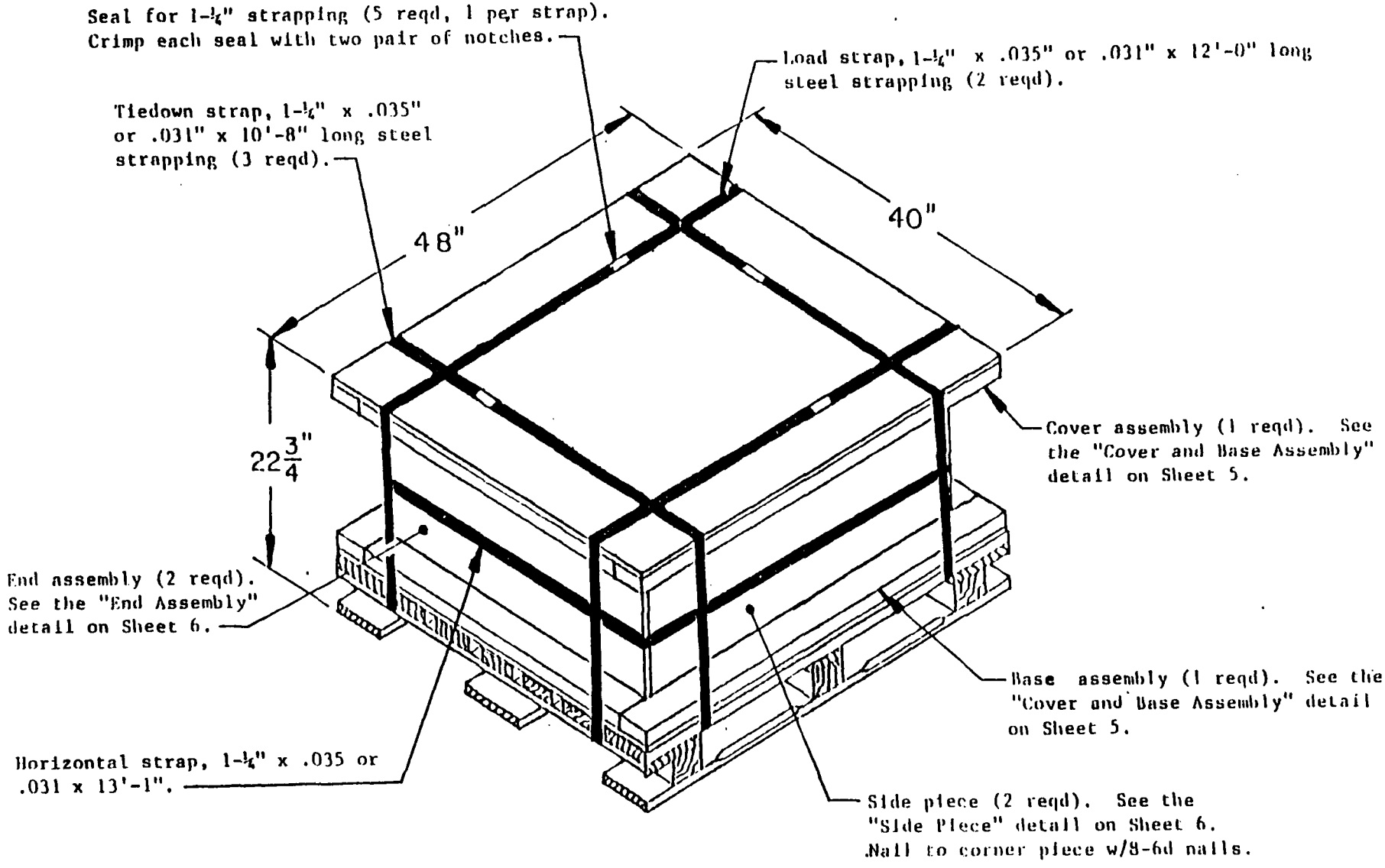
ATTN: SMCAC-DEO
Savanna, IL 61074-9639



PALLET UNIT

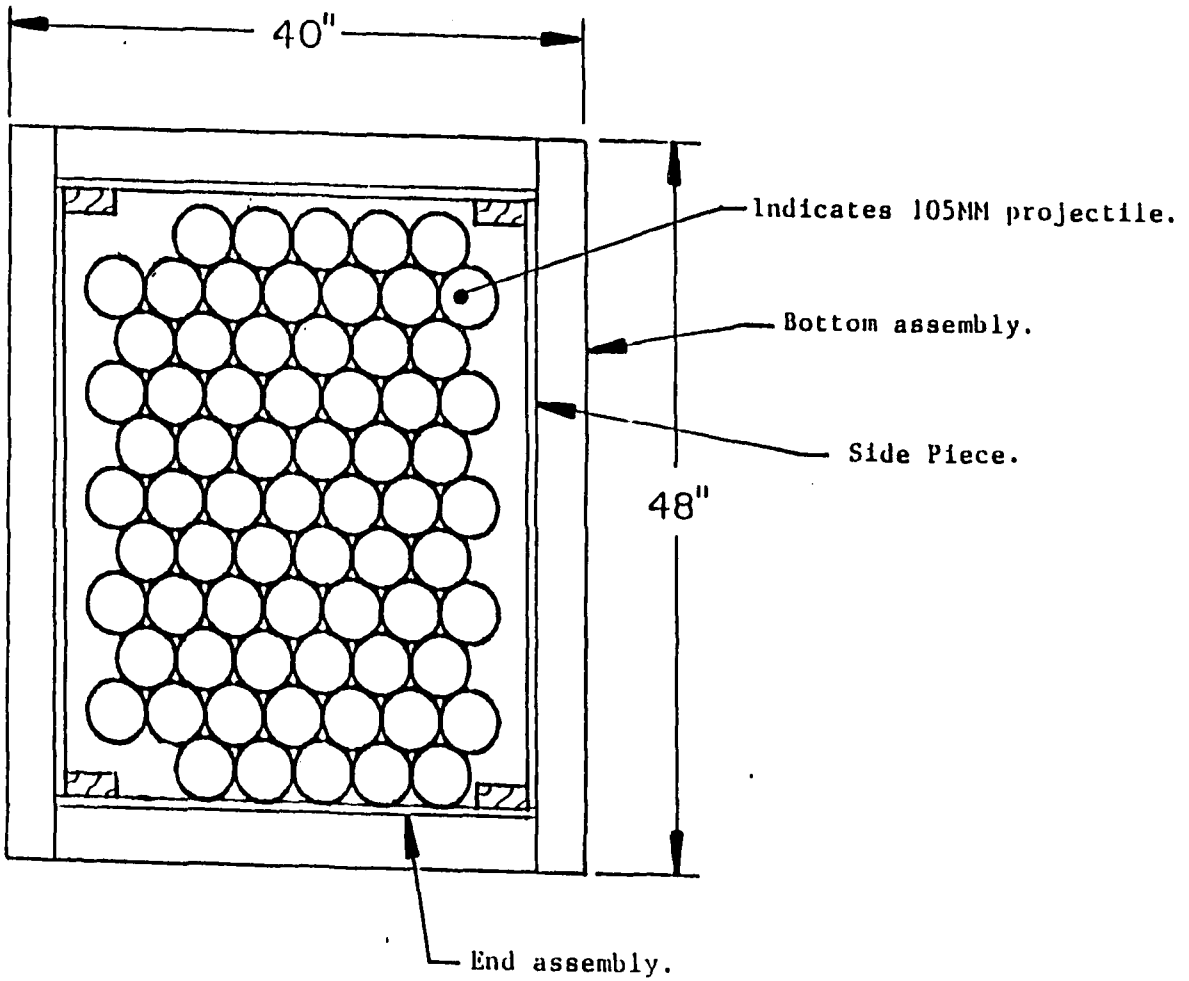
See the "Pallet Assembly" detail on Sheet 4

69 105MM Projectiles @ 25 Lbs----------1,725 Lbs
Dunnage---------- 144 Lbs
Pallet---------- 80 Lbs

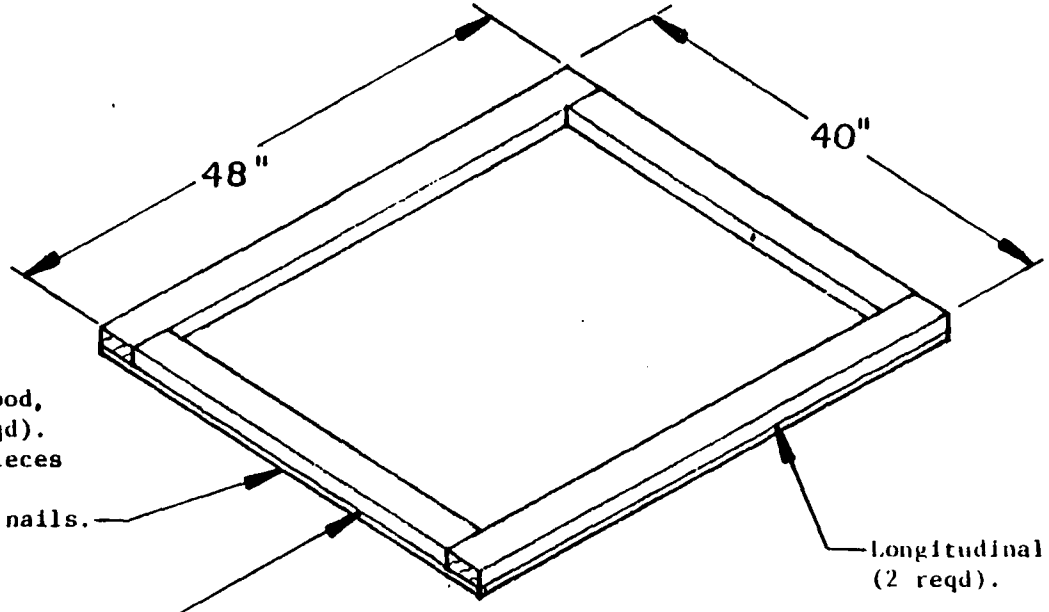
Total Weight---------- 1949 Lbs
Cube----------25.3 Cu Ft

BILL OF MATERIAL		
LUMBER	LINEAR FEET	BOARD FEET
2" x 4"	34.58	23.05
NAILS	NO. REQD	POUNDS
6d	188	1.11

Pallet, 40" x 48" ---------- 1 reqd---------- 80 Lbs
Steel strapping, 1-¼" -------- 58.41' reqd---------- 8.35 Lbs
Seal for 1-¼" strapping-------- 5 reqd---------- NIL
Plywood, 3/4" ---------- 42.53 sq ft reqd---------- 87.72 Lbs



PALLET ASSEMBLY DETAIL

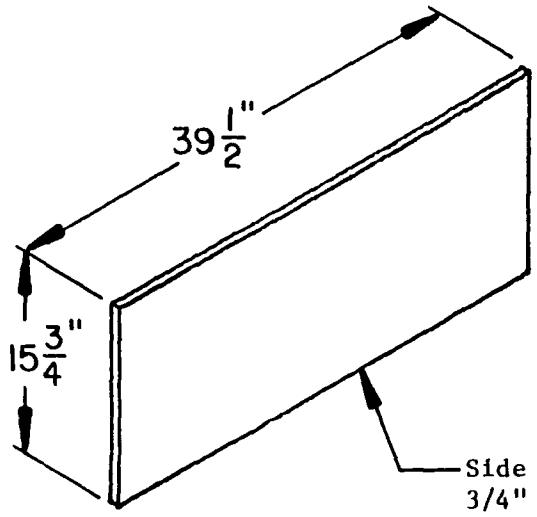


Deck/cover piece, plywood, 3/4" x 40" x 48" (1 reqd). Nail to longitudinal pieces w/20-6d nails and to lateral pieces w/15-6d nails.

Lateral piece, 2" x 4" x 40" (2 reqd).

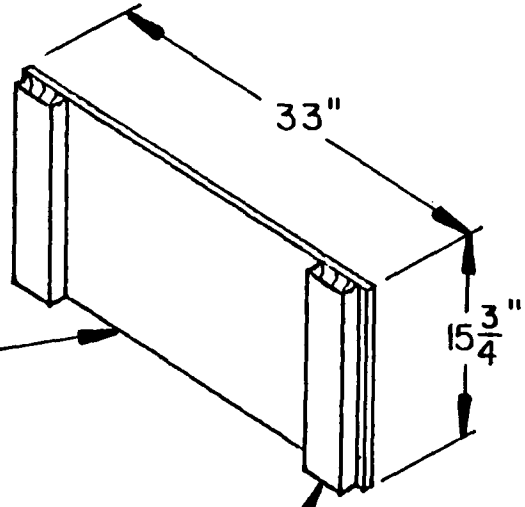
Longitudinal piece, 2" x 4" x 48" (2 reqd).

COVER AND BASE ASSEMBLY



Side piece, plywood, 3/4" x 15-3/4" x 39-1/2" (1 reqd).

SIDE PIECE



End piece, plywood, 3/4" x 15-3/4" x 33" (1 reqd).

END ASSEMBLY

Corner piece, 2" x 4" x 15-3/4" (2 reqd). Nail to plywood w/4-6d nails.